

Home drying of fruits and vegetables



Agriculture
Canada

Publication 1739/E



Canada

Photography
Bill Fleming

© Minister of Supply and Services Canada 1982

Available in Canada through

Authorized Bookstore Agents
and other bookstores

or by mail from

Canadian Government Publishing Centre
Supply and Services Canada
Ottawa, Canada, K1A 0S9

Catalogue No. A73-1739/1982E

Canada: \$2.95

ISBN 0-660-11152-7

Other countries: \$3.55

Price subject to change without notice

CONTENTS

Introduction / 4

Eight steps to successful home drying / 4

1. Selecting the drying method / 4
2. Selecting the equipment / 5
3. Selecting and preparing the raw food / 8
4. Predrying treatment / 8
5. Loading the drying trays / 8
6. Drying temperature and time / 18
7. Testing for dryness / 18
8. Conditioning, packaging, and storing / 19

Home-dried vegetables / 19

Selection and preparation / 19

Blanching / 19

Home-dried fruits / 21

Selection and preparation / 21

Sulfuring / 21

Syrup blanching / 22

Ascorbic acid bath / 22

Salt solution / 23

Fruit leathers / 23

Drying technique / 23

Suggested mixtures for leathers / 24

Using home-dried fruits and vegetables / 26

General uses / 26

Recipes / 27

Questions and answers on home drying of food / 29

Building a home dryer / 31

Cabinet / 31

Trays for the dryer / 33

Refrigerator / 34

Solar drying / 34

Direct sunlight / 34

Greenhouse or cold frame / 34

Solar collector / 34

Points to consider when buying or building a dryer / 37

Home drying of fruits and vegetables

B. J. Edwards and G. E. Strachan
Research Station, Summerland, British Columbia

INTRODUCTION

There is no written record of the origins of food drying. The wizened little morsels of food with their attractive earthy colors have been a part of the human diet all through the ages — in great and simple societies, peace and war, feast and famine. The current return to basic nourishing foods, combined with an appreciation of the benefits of hiking, camping, cross-country skiing, and similar outdoor activities, has made people aware of the convenience and advantages of preserving food by drying. Dried foods are lightweight, compact, nutritious, and attractive, and they are versatile enough to be used every day as snacks.

Drying removes enough water from food to inhibit the growth and reproduction of spoilage organisms such as molds, yeasts, and bacteria. Steaming or water blanching destroys enzyme activity and is an essential predrying treatment for vegetables. Enzymes that are present naturally in fruits and vegetables are responsible for the ripening process, which causes color and flavor changes, nutrient deterioration, and eventual spoilage. Although sulfite treatment of light-colored fruits before drying is not essential, it will stop enzyme activity, improve color and flavor, and help to retain essential nutrients.

The mechanics of drying are not difficult and the rules are straightforward, but they must be closely followed for successful results. Shortcuts can result in unsafe, unstable, or unattractive food that lacks flavor and has significantly lower nutritional value. Home drying is fun and can be rewarding, either as a hobby or as an alternative means of preserving the summer harvest for the cold days of winter.

General instructions for drying are given in "Eight Steps to Successful Home Drying." Specific instructions for handling most common fruits and vegetables are in the sections that follow.

EIGHT STEPS TO SUCCESSFUL HOME DRYING

1. Selecting the drying method

Home drying methods can be grouped into two categories: outdoor and indoor. To be effective, drying food outdoors requires a dry climate with consistently high temperatures. Drying food indoors requires less time and is not dependent on climatic factors. Descriptions of various methods follow.

Outdoors

Sun drying

Sun-dried foods are dried outdoors on drying trays and covered with cheesecloth to discourage insects. A roof slanted toward the sun is a good place for drying food. Do not place trays directly on the ground. Allow room for air circulation.

Solar dryer

A solar dryer can be used to intensify the sun's rays and protect food from contamination. The heat from the sun's rays that passes through glass is kept within the container, not dissipated. The dryer must face the sun throughout the drying period (Fig. 1).

Indoors

Oven

An ordinary cooking oven can be used. Stack trays at least 6 cm apart. Monitor temperature with a thermometer and leave the door slightly ajar to allow moisture to escape. If you are using an electric stove, turn on the lower heating coil only. Rotate trays every half hour throughout the drying period to prevent scorching.

Convection dryer

A convection dryer relies on air currents from heated air to circulate heat and remove the moisture. A heat source such as light bulbs or a hot plate is on the bottom of the dryer with the drying trays stacked above it.

Forced-air dehydrator

An electric fan is used to circulate heated air over the food being dried. Drying is more rapid and uniform with this method than with the other two indoor methods, and there is therefore less nutrient and flavor loss.

2. Selecting the equipment

Drying trays

Drying trays are designed to hold the food during sulfuring and drying. They are constructed to allow circulation of air over the fruit. If you select fiber glass screening, it must be used with caution because the binding agent deteriorates and fine glass fibers can be released into the dried fruit. Monofilament plastic screens, such as saran screening, are best, but sometimes the material is difficult to obtain. With the exception of stainless steel, metal screening is not recommended because it can be corroded by the sulfur fumes or fruit acid, or both. Perforated tempered hardboard makes acceptable trays, but it should be saturated with food-

grade mineral oil at the beginning of the season to prevent the fruit from sticking. Thin hardboard can be obtained from building-supply stores, and most dealers will cut it to size for a small charge.

Drying cabinets

A drying cabinet (Fig. 2) should be tightly constructed and have a source of warm air circulating through it to carry the moisture away from the fruit (see section entitled "Building a home dryer"). It is preferable, but not essential, to be able to adjust the temperature. In either case the maximum temperature must be maintained below 70°C. The heater should be capable of allowing the temperature to reach 65°C.

Sulfur

Sulfur may be used in the form of either a sodium or potassium metabisulfite solution or as flowers of sulfur. Sulfur candles are helpful for igniting sulfur; they can be obtained from a winemaking supply store. Use a foil pan for burning sulfur and a plastic pail for a metabisulfite dip.



FIG. 1 A simple but effective solar dryer, with plastic cover (see Fig. 16a for construction details).

Utensils

- Knives or shredders for preparing the food for drying.
- Large saucepan or preserving kettle, perforated spoon, and pot with steam rack, for syruping fruit or for water and steam blanching.
- Thermometer for monitoring drying temperatures.
- Kitchen scales for determining moisture losses and measuring fruit for sulfur requirements.
- Sugar, corn syrup, ascorbic acid, citric acid, or salt, for syrup or anti-browning dips.
- Large stainless steel (not aluminum) or enamel container, flake lye, rubber gloves, plastic apron, and eye protection for lye treatment of whole prune-plums.
- Preserving jars, polyethylene bags, or other airtight containers for storing dried foods.

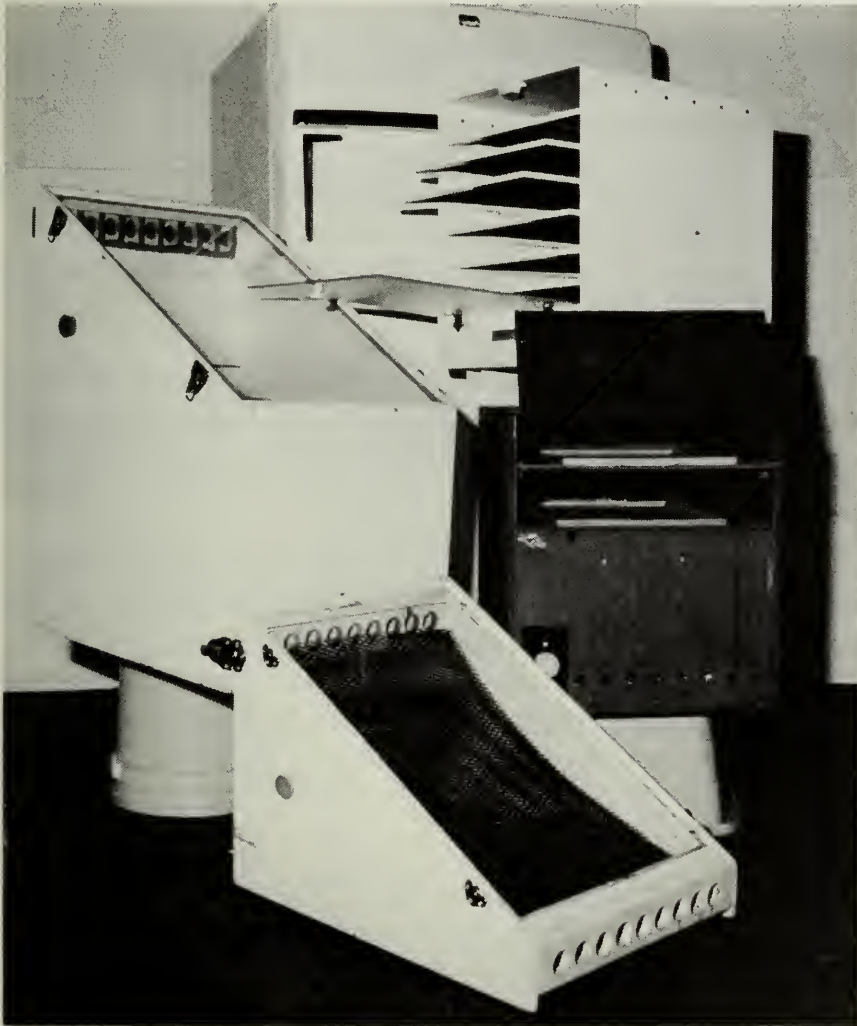


FIG. 2 Drying cabinets. Clockwise from foreground: a home-built solar dryer with flat-plate collector as preheating section; a converted refrigerator; a small, commercially built dryer for home use; a home-built cabinet dryer with light-bulb heat source (see Fig. 12a–12d for construction details).

3. Selecting and preparing the raw food

Select top-quality fruits and vegetables that are sound, fresh, mature, and of uniform size. Prepare foods quickly and carefully, and avoid bruising or abrading them. Wash all foods thoroughly before preparation. To obtain a uniform end product, each batch of food should be sliced and treated the same way throughout the drying process. Once it is washed, peeled, sliced, and pretreated, the food is ready for immediate drying. In this predrying state, fruits and vegetables that are not dried oxidize quickly, losing their color, freshness, and flavor, and nutritional value is reduced.

4. Predrying treatment

Some fruits and almost all vegetables begin to spoil when the flesh is cut and exposed to air. Spoilage caused by enzymes and microorganisms can be retarded by an appropriate predrying treatment. Almost all foods benefit from some form of predrying treatment. It helps to retain color, flavor, and nutritional value, and softens the tissue, enabling the food to dry quickly and be reconstituted more easily.

For many fruits predrying treatments are optional; for most vegetables, the treatments described are essential for retarding bacterial growth and preventing spoilage during drying.

Steam or water blanching is an essential step for preparing nearly all vegetables for drying. Blanching inactivates enzymes that are responsible for unwanted changes in product quality, reduces bacterial contamination, and opens the tissues to allow faster drying. Instructions for blanching are given in Table 1.

There are several alternative antioxidant dips that can be used as predrying treatment to prevent browning during preparation and drying: 10 mL ascorbic acid/250 mL water; 10 mL salt/1 L water; 30 mL citric acid/250 mL water; or 30 mL lemon juice/250 mL water. Additional predrying treatments include: short boiling-water dip, to finely crack skins; syrup, water, or steam blanch; or fumes of burning sulfur or metabisulfite dip for long-term preservation of fruit. Instructions for using these treatments are given in Table 2.

5. Loading the drying trays

It is important not to overload trays and to allow space between the pieces of food for air circulation. The dryer should provide enough heat to remove water from the food but not to cook it. There must be enough

air movement to vent this water from the dryer. If a vertical-flow dehydrator or oven is used, the drying trays should be staggered to create a serpentine pattern of air circulation. Arrange large pieces of food in a single layer on the trays and smaller pieces or leafy greens in layers not more than 1–2 cm deep. Pitted or sectioned fruit should be placed cut side up on the trays to hold the natural juices that are released during the initial stages of the drying process.

Table 1. Home drying of vegetables

Vegetable	Preparation	Predrying blanch (times vary with size of food)	Drying procedure and time (for dehydrator)	Test for dryness and color
Beans, green	Select fresh tender beans, discarding those that are overmature or woody. Wash, trim ends, cut into 3-cm pieces, split lengthwise or leave whole.	Steam: 12–20 min Water: 4–5 min (or until tender but firm) Cool immediately.	Spread in a 2-cm layer on drying trays. 5–8 hours	Brittle; dark green
Beets	Select young, firm, tender beets. Leave root and 3 cm of top to prevent bleeding. Wash carefully to avoid abrasion.	Steam: 30–45 min, un- til completely cooked. Boiling causes excess bleeding. Peel, remove top and root, cut into slices 0.5 cm thick, cube, or grate.	Spread in a single layer on drying trays. Spread grated beets in a 1-cm layer and turn often. 4–8 hours	Tough, springs to shape when bent; dark red black; grated beet is brittle.
Broccoli	Select broccoli flowerets and tender stalks. Wash and trim, retaining stalks that are less than 3 cm in diameter.	Steam: 6–10 min Water: 3–5 min (or until tender but firm) Cool immediately.	Spread in a single layer on drying trays. Reduce drying temper- ature near end to pre- vent scorching. 5–6 hours	Brittle; dark green blue.
Cabbage	Remove coarse, wilted or damaged leaves, core, and quarter. Savoy and other loose- headed cabbage are best.	Steam: 4–6 min (or until midribs are translucent) Cool immediately.	Remove leaves and spread on drying trays in a layer 1 cm thick or less. Turn or stir occasionally to prevent matting. Lower temperature near end of drying. 5–6 hours	Crisp; natural yellow green with slight trans- lucence.

Carrots	Select fresh, firm carrots. Remove tops and peel. Cut into 0.5-cm cubes, rounds, or slices. Use young, tender whole carrots; remove tops and scrape clean.*	Steam: 4–10 min Water: 3–6 min (or until tender but firm) Cool immediately.	Spread in a single layer on drying trays. 6–9 hours	Leathery to brittle, depending on length of drying; deep orange.
Corn, sweet	Select fresh, tender corn, avoiding overmature cobs; husk. Corn should be in the milk stage.	Steam: 13–15 min Water: 7–8 min (or enough time to set milk) Cool immediately. Remove kernels from cob as for canning or freezing.	Spread in a 1-cm layer on drying trays. Stir often to prevent lumping (kernels stick readily because of high starch content). 8–9 hours	Brittle; golden yellow.
Herbs parsley, mint, chives, dill, basil, celery leaves, sage, and all other aromatic herbs.	Select leaves from upper 15 cm of stalk when plants have just come into bloom. Rinse or spray branches with cold water to clean. Towel dry.	No predrying treatment necessary.	Spread in a single layer on drying trays. Avoid light if possible. Dry at low temperature (38°C) to retain natural oils, flavor, and aroma. Remove stems before packaging. 5–7 hours	Brittle, crumbles readily; retains color with slight darkening.

*Whole carrots and potatoes can be kept in a root cellar without drying.

Table 1. Home drying of vegetables (*continued*)

Vegetable	Preparation	Predrying blanch (times vary with size of food)	Drying procedure and time (for dehydrator)	Test for dryness and color
Mush- rooms	Select firm, fresh, clean mushrooms. Wash with cool water. Slice caps vertically and stems lengthwise or in rounds. Very small mushrooms can be dried whole; very large ones require peeling.	No predrying treat- ment necessary.	Dry stems and caps separately for a more uniform product. Spread on drying trays in a layer 1 cm thick. 4-6 hours	Leathery to brittle; re- tains color with slight darkening.
Onions	Select firm onions with no evidence of sprout- ing. Remove outer skins and slice into 0.5- cm rings or dice. Uni- formity in slicing is essential.	No predrying treat- ment necessary.	Spread in a 2-cm layer on drying trays. Turn occasionally for even drying. 6-8 hours	Crisp and brittle enough to grind to powder; light color; pungent.
Peas	Select young, tender peas. Shell and blanch immediately.	Steam: 8-10 min Water: 3-4 min Cool immediately.	Spread 1 cm deep on drying trays. Finish drying at low tempera- ture to prevent scorch- ing. 6-7 hours	Wrinkled and brittle; dull green; shatters when hit with a hammer.
Peppers	Select firm, crisp pep- pers. Wash, remove seeds and stems, and cut into strips 0.5-1.0 cm thick or rings.	No predrying treat- ment necessary. Optional steam: 6-8 min	Spread in a 2-cm layer on drying trays. Turn often for even drying. Non- treated peppers take longer than steam- blanched peppers. 5-8 hours	Brittle; dark green; thinnest, overdried pieces will be dark green.

Potatoes	<p>Select firm, good-quality white potatoes. Wash, peel, and cut into slices 0.5 cm thick, cubes, or strips. Dip into cold water. Blanch immediately for best results.*</p>	<p>Steam: 7–8 min Water: 4–5 min <i>Note:</i> Steamed potato slices are sticky because of high starch content.</p>	<p>Spread in a 1-cm layer on drying trays. Turn often to avoid sticking. 6–8 hours</p>	<p>Brittle; white; translucent appearance.</p>
Pumpkin and winter squash	<p>Select well-matured pumpkin and squash with solid flesh and good color. Wash, cut in half, and remove seeds and pith. Cut into 1-cm cubes. Or, remove rind and shred.</p>	<p>Steam: 6–8 min Cool immediately. Remove rind.</p> <p>Steam: 3–5 min Cool immediately.</p>	<p>Spread in a single layer on drying trays. Turn regularly for even drying. 5–6 hours</p> <p>Spread shredded squash in a 1.5-cm layer on drying trays. Turn often for even drying. 4–5 hours</p>	<p>Brittle; yellow orange color.</p>
Spinach	<p>Select fresh, tender leaves; trim stems and remove damaged leaves. Wash in cold water and blanch immediately.</p>	<p>Steam: 3–5 min (or until leaves are wilted and midribs are translucent).</p>	<p>Spread in a single layer on drying trays. Keep temperature low, especially near end of drying, because leaves scorch readily and darken. 5–6 hours</p>	<p>Brittle; crumbles readily; dark dull green.</p>

*Whole carrots and potatoes can be kept in a root cellar without drying.

Table 1. Home drying of vegetables (*concluded*)

Vegetable	Preparation	Predrying blanch (times vary with size of food)	Drying procedure and time (for dehydrator)	Test for dryness and color
Tomatoes	Select plump, mature but firm tomatoes. Wash and quarter or cut into 0.5-cm slices. No peeling required.	No predrying treat- ment necessary.	Spread in a single layer on drying trays. Finish drying at low temperature to pre- vent scorching. 7-9 hours	Very dry but pliable; light orange red with dark red skin; translu- cent appearance.
Zucchini	Select firm zucchini of moderate size. Wash and cut into 0.5-cm slices. No peeling re- quired.	Steam: 4-5 min. Water: 1½-2 min	Spread in a 1-cm layer on drying trays. Turn regularly. 6-8 hours	Brittle chips; white when dry with dar- kened green skin; chips are good with dips.

Table 2. Home drying of fruit

Fruit	Preparation	Predrying treatment	Drying procedure and time (approximate)	Test for dryness and color
Apples	Select mature eating apples with firm light- colored flesh. Peel, core, trim, and cut into eighths or slice into 0.5-cm rings. Drop im- mediately into ascorbic	Sulfur dip: 5 min into 4% potassium metabi- sulfite solution. Drain and store in a closed container or sealed plastic bag overnight to allow penetration	Spread in a single layer on drying trays. Lower temperature near end of drying to prevent scorching. Dehydrator: 12-15 hours	Leathery and pliable; returns to original shape when bent and squeezed; creamy white. Apples are over- dry when they become crisp and hard.

acid solution or brine to prevent browning.		and equilibration. Sulfur burn: 5 mL of powdered sulfur per 500 g of fruit; ignite and leave with fruit in closed chamber or cabinet for 12 hours.		Sun: 2-4 days	
Apricots	Select mature apricots. Wash, halve, and pit. Do not peel.	Sulfur dip: as for apples. Sulfur burn: as for apples. Arrange fruit on trays as in drying procedure.	Place cut side up on trays to retain natural sugars in the juice. Turn fruit when juice no longer drips from the flesh. Dehydrator: 16-24 hours Sun: 2-4 days	Leathery and pliable, not sticky, returns to original shape when bent and squeezed; darker, duller orange than fresh fruit.	
Bananas	Select only ripe or overripe bananas. Peel, quarter, or slice into 0.5-cm rounds. Whole bananas can be dried for 1 day and then sliced, yielding a chewier product. If desired, dip into ascorbic acid solution to prevent browning.	No predrying treatment necessary.	Spread in a single layer on drying trays, fleshy side up (if quartered) to prevent sticking. Keep temperature low to prevent scorching. Dehydrator: 6-8 hours Sun: 2-3 days	Leathery and pliable; creamy white, darker in center. If drying for chips, dry until brittle.	
Cherries	Select choice, mature, sweet dark cherries. Wash, remove stems, and pit.	No predrying treatment necessary, but flavor will change if not treated. Cherry flavor can be maintained with sulfuring.	Spread in a single layer on drying trays. Dehydrator: 12-16 hours Sun: 3-4 days	Sticky but not moist with juice; raisin-like appearance; dark, almost black.	

Table 2. Home drying of fruit (*concluded*)

Fruit	Preparation	Predrying treatment	Drying procedure and time (approximate)	Test for dryness and color
Grapes	Select seedless, high-sugar grapes. Wash and leave whole.	Boiling water dip: 15 sec to split skins. Cool immediately. Sulfuring is optional.	Spread in a 3-cm layer on drying trays. Stir often to prevent clumping and to obtain even drying. Dehydrator: 8–12 hours Sun: 2–3 days	Leathery and sticky with no juice; red grapes are dark blue; sulfured green grapes are golden yellow; and nonsulfured green grapes are dull brown.
Leathers	Select fully ripe fruit and prepare as you would for regular drying; peeling is optional. See p.24 for suggested mixtures.	Cook until soft: apples, prunes, apricots, cherries, peaches, and pears. Puree in food mill or blender; or add 1 mL pure ascorbic acid to each litre of pureed fruit; or add 0.5 mL sodium metabisulfite to each litre of light-colored fruit puree.	Lay plastic wrap over leather-drying tray and spread puree in an even layer, 0.5 cm thick. Dehydrator: 6–12 hours Sun: 2 days	Leathery and chewy; peels easily from plastic wrap when dry.
Peaches	Select mature but not overripe freestone peaches. Halve and remove pit. Steam about 2 min; remove skins.	Sulfur dip: as for apples. Sulfur burn: as for apples. Arrange fruit on trays	Place in a single layer, on drying trays, cut side up, to retain juice. Turn fruit when juice no longer drips from	Leathery and pliable; returns to original shape when bent and squeezed; golden yellow.

	as in drying procedure.	Sulfur dip: as for apples. Sulfur burn: as for apples. Arrange fruit on trays as in drying procedure.	Place in a single layer on drying trays, cut side up, to retain juice. Turn fruit when juice no longer drips from the flesh. Dehydrator: 16–20 hours Sun: 3–5 days	Leathery and pliable; off-white, no browning if pretreated with sulfur.
Pears	Select mature, unbruised pears. Peel, halve, and core.			
Prunes	Select fully ripe fruit. Fruit recently fallen to the ground will be high in sugar and good for drying. Wash, halve, and pit or leave whole.	For whole prunes the skin must be finely checked or cracked. Boiling water dip: 15–20 sec in water just below boiling point. Cool immediately.*	Place halves in a single layer on drying trays, cut side up, to retain juice. Dehydrator: 16–20 hours Sun: 3–4 days Whole fruit Dehydrator: 20–24 hours Sun: 4–6 days	Pliable and leathery; dark blue black.

*Option: Add 30 mL baking soda to boiling water dip to aid checking. Or, mix 30 mL lye with 4.5 L water (0.67%) in a stainless steel kettle; heat just below the boiling point, dip prunes for 15–20 sec, and rinse thoroughly in cold water.
Note: Handle lye-dipped prunes with rubber gloves and glasses for protection.

6. Drying temperature and time

Indoor dryers are efficient at 40–70°C. At the beginning of drying, the temperature should be low, to prevent case hardening of the tissues; the temperature should then be increased by 20–30°C over 1–1½ hours. Case-hardened products become tough and dry, rehydrate poorly, and lose some flavor and nutrients. The temperature for most of the drying period should be high enough (60–70°C) to inhibit spoilage organisms and to remove the moisture from the food at an efficient rate. The food should be turned or stirred often to ensure even drying and to prevent clumping. When most of the water has been removed, the food becomes heat-sensitive and prone to scorching. At this point the temperature should be dropped by 20–30°C and the food inspected and stirred regularly.

Dehydration time depends on shape and thickness of the food, moisture content, predrying treatment, dryer load, dryer humidity, temperature, and rate of air venting. Home dehydrators usually dry food in 4–15 hours. Most vegetables have a low sugar and acid content, and should therefore be dried as quickly as possible to prevent deterioration.

Sun drying in the open air requires more time than sun drying in an enclosed dehydrator — usually 2–6 days. Both types of sun drying are more effective in a dry climate with consistently high temperatures. Foods dried in the open air should be exposed to a minimum of pollution. Cover open trays with cheesecloth to keep out insects and dust. A low-sloping roof makes an ideal drying location. Food that is being dried outdoors should be covered or taken indoors at night to prevent condensation and rehydration. A solar dryer is faster than open-air sun drying, the food is exposed to fewer contaminants, and it costs nothing to operate.

Sun-dried food requires the same treatment as food dried indoors, but it takes longer to dry.

7. Testing for dryness

With so much variation in foods, dryers, and drying conditions, exact drying times cannot be specified. Instead, approximate times, appearance, and texture are used to assess moisture content. To test food for dryness, remove a piece and allow it to cool to room temperature. Foods that are hot from the dryer or sun seem more moist and pliable than when they are cool.

Vegetables are usually dried to less than 5% moisture, and fruits to less than 20%. Dried vegetables are brittle, tough, crumbly, or crisp; very few can be described as leathery. Adequately dried fruits are pliable, often leathery, with no evidence of surface moisture or juice. Most fruits lose their stickiness, except those with a very high sugar content such as cherries and grapes. A handful of dried fruit that is squeezed should separate into pieces and spring back to its original shape when the pressure is released. When you become familiar with the appearance and

texture of food as it is drying, you can judge the various stages of the drying process.

Tests for dryness of specific fruits and vegetables are listed in Tables 1 and 2.

8. Conditioning, packaging, and storing

The moisture content of dried foods is not uniform after drying is completed and must be equilibrated by “conditioning” to ensure a longer storage life. Condition foods in an airtight nonmetal container such as a strong plastic bag, glass jar, crock, or plastic container. Fill the container to the top to reduce the amount of air, seal, and store in a cool, dry location. Stir the mixture daily for 4–10 days, depending on the type and size of food; if it is too moist after conditioning, return it to the drying trays.

Pasteurization is recommended for vegetables dried outdoors and for those dried indoors at temperatures less than 65°C. To pasteurize food, spread it loosely on trays and heat in an 80°C oven for 10–15 minutes; spread the food on clean towels to cool and package it immediately.

Package the food in plastic bags, plastic containers, or glass jars, packing it tightly to remove air. Seal bags securely with tape, rubber bands, or twist ties and store in insect-proof containers such as crocks, plastic pails, or coffee tins. The storage location should be dry and dark, and the temperature should be below 15°C. Dried foods can also be stored in a refrigerator or freezer. Label and date the products, and check them monthly for moisture buildup and spoilage. If a product has absorbed moisture, heat in a 70°C oven until dry and repackage it. Always use the oldest foods first to avoid waste.

HOME-DRIED VEGETABLES

Selection and preparation

Select choice-quality, tender vegetables that are freshly harvested. Overmature vegetables are often tough or mealy and make a poor dried product. Wash and prepare them as outlined in Table 1.

Blanching

Blanching is an essential predrying treatment for vegetables. It inhibits spoilage and produces a dried product that has better flavor and color and is easier to rehydrate. Blanching times vary for each vegetable (see Table 1).

Water blanch

Bring a large pot of water to a vigorous boil. Use 4 L of water for 500 g of vegetables. Place vegetables in a wire basket or cheesecloth bag and lower them into the water. Measure blanching time from the time the water resumes boiling. After blanching, chill immediately with cold running water and drain.

Steam blanch

In a steamer bring 5 cm of water to a vigorous boil. Place a 5-cm layer of vegetables in a basket (Fig. 3) and suspend above the boiling water. Steam must circulate freely around the vegetables. Cover and steam for the recommended time. After blanching, chill immediately with cold running water and drain.

The blanching times required may vary from those recommended; thus each batch should be checked. Most vegetables will appear translucent and feel soft; they should be heated throughout but not cooked. If the pieces are hard, reblanch them — this is important.



FIG. 3 Equipment suitable for steam or water blanching.

HOME-DRIED FRUITS

Selection and preparation

Select high-quality fruit that is ripe but firm. Overmature fruit bruises easily and spoils quickly, and underripe fruit lacks the natural sugars necessary for a good product. Wash the fruit well and prepare it as outlined in Table 2.

Sulfuring

The use of sulfur, by either the dipping or burning method, is a highly recommended predrying treatment for many fruits, although it is not mandatory. Sulfuring has been attacked by some consumers and by advocates of natural foods, who maintain that it is done primarily for cosmetic reasons. Sulfuring does prevent discoloration but it also helps to retain flavor and nutritional value (vitamins A and C), and prolongs storage life. Sulfur inhibits mold, yeast, and bacterial growth during drying and in storage. It accelerates drying and helps to repel insects.

Metabisulfite dip

A 4% metabisulfite dip is prepared by mixing about 180 mL sodium metabisulfite or potassium metabisulfite and 4.5 L cold water in a plastic pail. Dip the prepared fruit into this solution for 3–5 minutes. Drain fruit and transfer to plastic bags or a bucket. Seal and refrigerate or store in a cool place for 12–24 hours while sulfite equilibrates throughout the fruit (Fig. 4). Metabisulfite should be prepared fresh daily but can be used for several batches of fruit without losing its effectiveness.

Sulfur burning

During sulfur burning, the fruit is exposed to fumes of burning sulfur. Burn the sulfur in the open air because the fumes are irritating to the nose, throat, and eyes. When sulfuring in a cabinet dehydrator (see section entitled “Building a Home Dryer”) remove the light-bulb bar and cover all vent holes with masking tape before using this box or any similar cabinet. Weigh the prepared fruit, place it on drying trays with cut surfaces up, and put it into the sulfuring chamber. For each 500 g of fruit, place 5 mL of flowers of sulfur into a foil dish and insert a strip of sulfur candle to help it ignite. If sulfur candles are not available, burn a charcoal briquette to hot ash in a foil pan and sprinkle the sulfur over it. Slide the burning sulfur into position under the racks and seal the cabinet. Avoid breathing the sulfur fumes. Allow the fruit to remain in contact with the sulfur for 8–12 hours. Sulfuring should be carried out on a paved or bare area because the treatment can smother or burn grass.



FIG. 4 Storage of sulfite-dipped fruit. After dipping, fruit can be stored overnight on drying trays. Plastic bag prevents release of sulfite to make dipping more effective.

Syrup blanching

Fruit can be blanched in a 60% sugar syrup (rather than sulfuring) to preserve color and flavor. Fruit that is syrup-blanced takes several hours longer to dry and must be protected from insects if it is dried outdoors. Prepare the blanching syrup by combining 250 mL sugar, 250 mL corn syrup, and 500 mL water (600 mL honey may be substituted for the sugar and corn syrup); 2 mL ascorbic acid or citric acid may be added to improve the color and flavor. Bring the syrup to a boil, add the prepared fruit in a single layer, and simmer until the fruit is heated throughout (5–12 minutes, depending on the size of the pieces). Drain the fruit and place it on drying racks. After each blanch, add about 75 mL water to the syrup to bring it to its original concentration and reuse it for several batches.

Ascorbic acid bath

Ascorbic acid baths can be used, although they are less satisfactory in preventing discoloration than either sulfur burning or dipping. Dissolve 10 mL pure ascorbic acid (vitamin C) in 250 mL cold water; dip the fruit into the bath for 1 minute, drain, and dry immediately.

Salt solution

A salt solution is a simple, temporary treatment to prevent browning. Dissolve 200 mL salt in 4 L water. Soak fruit for 5–10 minutes, drain, and dry.

FRUIT LEATHERS

Drying technique

A thin, chewy layer of dried, pureed fruit is known as a leather. Almost any combination of fruit can be used. Be imaginative — add honey, maple syrup, brown or white sugar, tropical fruits, spices, or simply use home-grown fruits alone. They are all delicious.

Use fully ripe fruit and prepare it as you would for regular dehydrating; peeling is optional. Apples, prunes, apricots, cherries, peaches, and pears retain better color and flavor if they are cooked until soft before they are pureed in a food mill or blender. Add 15–20 mL sugar or honey for each 250 mL pureed fruit; sweetness can be adjusted to personal preference. If fruits are not cooked, ascorbic acid will help to reduce browning. Add 1 mL pure ascorbic acid (dissolved in a small amount of water) to each litre of pureed fruit and mix well.

A small raised border attached to a drying tray (Fig. 5) or cookie sheet serves as a form for containing the fruit puree. Lay a piece of plastic wrap over the form and spread the puree smoothly and evenly (0.5 cm thick) over it (Fig. 6). Dry the fruit until it is leathery and chewy, but not crisp. Peel the leather away from the plastic wrap (Fig. 7); if it does not peel away

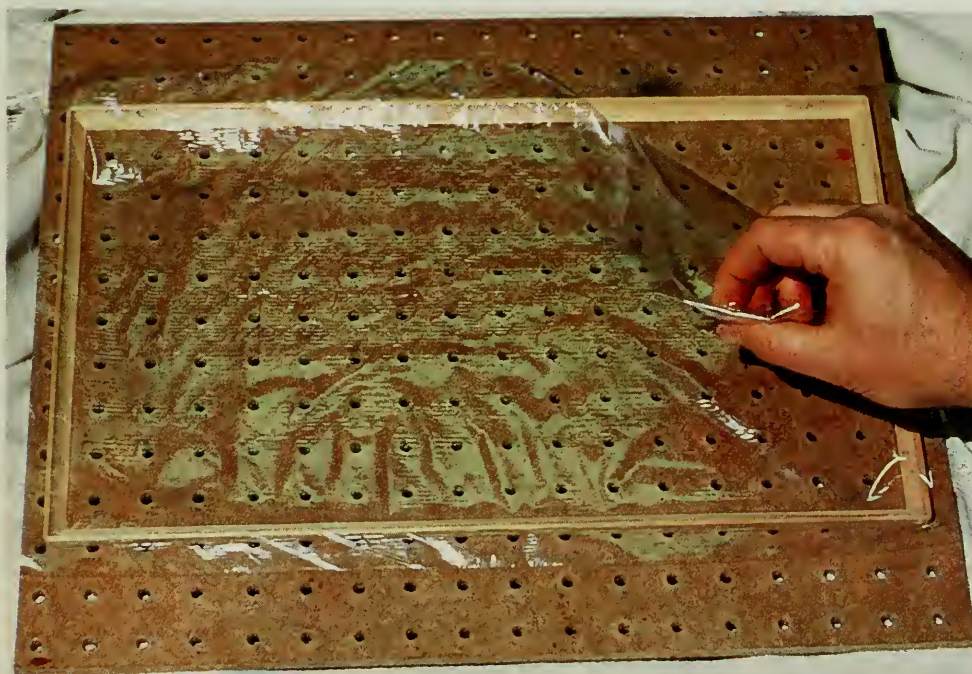


FIG. 5 A drying tray with a raised border for making fruit leathers.

easily, it requires further drying. If leathers do not have a uniform thickness they will dry unevenly, with thinner areas becoming overdry and brittle. When the leather has dried, roll it up in the plastic film (Fig. 8) and store in an airtight container in a dark, cool place. A roll of leather can be stored successfully in a cardboard mailing tube or a tube from wax paper.

There are many combinations of fruits, spices, and sweeteners, as one soon discovers when experimenting with leathers (Fig. 9). The section that follows lists a few particularly tasty ones.



FIG. 6 Pouring the fruit puree into a drying tray covered with plastic wrap.

Suggested mixtures for leathers

Ingredients added are based on approximately 650 mL of fruit puree. All mixtures can be sweetened to taste, if desired.

- One single fruit with no additional ingredients: apricot, prune-plum, apple, pear, raspberry, or peach.
- Apricot and nectarine or apricot and sour cherry.
- Spiced apple (2.5 mL cinnamon, 1 mL cloves, dash nutmeg) with nuts, sesame seeds, or raisins.
- Spiced apple with yogurt (125 mL), with or without chopped raisins.
- Apple with peanut butter (60 mL).
- Spiced crab apple with coconut (125 mL) or sesame seeds.
- Pumpkin, steamed and pureed (250 mL), 1 egg, 60–80 mL honey, 125 mL evaporated milk, 2.5 mL cinnamon, 1–2 mL ginger, 1 mL cloves.



FIG. 7 Properly dried fruit leather peels away easily from the plastic wrap.



FIG. 8 Roll leather and plastic wrap together, and store.



FIG. 9 A selection of leathers, showing colors and textures. Center is spirals of prune leather cut from a roll.

USING HOME-DRIED FRUITS AND VEGETABLES

General uses

Not all dried foods need to be reconstituted. Leathers can be used as snacks or desserts; they are also a source of energy when camping, backpacking, or engaging in other strenuous activities. Dried fruits can be eaten alone as a nutritious snack or combined with coconut, nuts, or seeds. Crispy dried fruits, such as apples, can be ground in a blender and used as a sweet topping for ice cream, puddings, or other desserts. Dried fruits can be simmered in water or apple juice for 10–15 minutes or until tender, sweetened if necessary, and eaten as a dessert. For baking, reconstitute dried fruit in a saucepan by adding just enough water to cover; let fruit

soak for several hours; cover and simmer until tender. The soaking and cooking liquid is also nutritious and can be used with the fruit in baking.

Vegetables, except for greens, must be rehydrated before cooking. Pour just enough boiling water over the vegetables to cover and set aside to soak until they return to their original size. Greens are simply simmered in boiling water until tender. Vegetables dehydrated rapidly at relatively high temperatures are reconstituted more satisfactorily than those dehydrated slowly at low temperatures. Cover the vegetables and simmer until tender. Use the soaking and cooking water in soups, stews, or casseroles.

Dried herbs and spices can be used individually or combined to taste. Discovering the many ways of using home-dried herbs and spices can be an enjoyable creative experience.

Recipes

It is easy to use dried food in recipes that call for fresh ingredients; substitute one-third to one-quarter less of the dried product or use the dried product in its rehydrated form. Experimenting with recipes is fun, and you will discover that you rarely go wrong. When trying new recipes and ideas, remember that the best guide to tasty food combinations is your own palate.

The authors acknowledge with thanks the contribution of Dorothy Britton, home economist (retired), Research Station, Summerland, B.C., who supplied many of the recipes.

FRUIT SOUP

500 mL mixed dried fruit	1 L water
(any combination of apricots, cherries, peaches, prunes, or apples)	1 medium orange, sliced
125 mL raisins	600 mL apple juice
2 or 3 cinnamon sticks	50 mL sugar
	10 mL quick-cooking tapioca
	1 mL salt

Combine mixed dried fruit, raisins, cinnamon sticks, and water. Bring just to the boil. Reduce heat and simmer, uncovered, until fruit is tender (about 30 minutes). Cut orange slices in half and add along with apple juice. Combine sugar, quick-cooking tapioca, and salt; gradually stir into fruit mixture. Bring mixture to the boil again and then immediately reduce heat. Cover and cook over low heat for 15 minutes, stirring occasionally. Serve warm or chilled. Serves 8.

APPLE PIE

250 mL dried apples (100–110 g)	10 mL lemon juice
625 mL warm water	pastry for 2-crust 20-cm pie
1 mL salt	1 mL cinnamon
125 mL sugar	2 mL nutmeg
10 mL quick-cooking tapioca	15 mL butter

Combine dried apples, warm water, and salt. Let stand 20 minutes. Simmer, covered, for 20 minutes, stirring occasionally. Stir in half the sugar. Combine quick-cooking tapioca with remaining sugar and gradually stir into apple mixture. Continue cooking until thickened and add lemon juice. Cool. Line 20-cm pie plate with half the pastry. Add cinnamon and nutmeg to cooked filling and pour into pastry shell. Dot with butter. Cover with remaining pastry, make slits for steam to escape, and flute the edges. Bake in 220°C oven for 40–45 minutes or until done.

CHERRY NUGGET BRAN MUFFINS

30 mL shortening	250 mL natural wheat bran
50 mL sugar	250 mL all-purpose flour
1 egg	5 mL baking powder
125 mL chopped dried cherries	3 mL baking soda
300 mL buttermilk	3 mL salt

Cream together shortening and sugar, and blend in egg. Add dried cherries, buttermilk, and bran. Combine and let stand until most of the moisture has been absorbed (12–20 minutes). Sift flour, measure it, and sift again with baking powder, baking soda, and salt. Add to first mixture, stirring only until combined. Spoon into greased muffin tins. Bake at 220°C for 20–25 minutes. Makes 12 muffins.

Note: For apricot nugget bran muffins follow above recipe, substituting 125 mL chopped dried apricots for cherries.

HERB DIP

250 mL cream cheese	5 mL dill weed
250 mL sour cream	5 mL soy sauce
15 mL chives	5 mL curry powder
15 mL parsley	5 mL tarragon

Allow cream cheese to reach room temperature. Mix ingredients thoroughly. Dip will harden slightly if refrigerated. Serve freshly prepared at room temperature.

CHERRY-COT LOAF

175 mL dried apricots	250 mL all-purpose flour
125 mL dried cherries	10 mL baking powder
200 mL warm water	5 mL baking soda
1 orange	5 mL salt
boiling water	2 mL mace
125 mL sugar	125 mL whole wheat flour
30 mL melted butter <i>or</i>	5 mL vanilla
margarine	1 mL almond extract
1 egg, beaten	125 mL chopped walnuts

Cover dried apricots and cherries with warm water and let stand for 1 hour. Drain, reserve liquid, and set aside. Squeeze orange and set juice aside. Retain half of the orange peel, remove white membrane, and cut the peel into pieces. Add to other fruit. Add reserved fruit liquid to orange juice and enough boiling water to make 250 mL liquid in all. Pour over fruit and chop in blender until fruit is in small pieces (do not puree). Pour mixture into a bowl and stir in sugar and melted butter *or* margarine. Add beaten egg, blend well, and set aside. Sift all-purpose flour, measure it, and sift again with baking powder, baking soda, salt, and mace. Combine with whole wheat flour. Stir dry ingredients into fruit mixture. Add vanilla, almond extract, and walnuts. Blend thoroughly. Spoon batter into a well-greased 2-L loaf pan. Bake at 180°C for 1 hour or until done. Cool on rack. Wrap in foil and store overnight before slicing.

QUESTIONS AND ANSWERS ON HOME DRYING OF FOOD

- Q. Why bother to dry foods?
- A. Drying is an inexpensive means of preserving foods for the off-seasons, with only 15–30% of the bulk of the original product. Lightweight, low-bulk dried foods are ideal for traveling, camping, or backpacking. They are also nutritious. Drying eliminates the need to preserve fruits with sugar. Home drying is a challenging and interesting activity, which requires only a few general rules for guidance.
- Q. Are foods dried naturally in the sun more nutritious than those dried by artificial means?
- A. No, in fact foods dried in the sun dry more slowly than those dried in dehydrators, thereby decreasing nutrient retention.
- Q. Why is it important to start with a low initial drying temperature, increasing it gradually to the desired temperature?
- A. Fresh foods case harden when exposed to too much heat too quickly. The outer tissues toughen and prevent water from evaporating or, alternatively, cells might rupture and the food will cook.

- Q. What is the nutritional value of dried fruits and leathers?
- A. Dried fruits and leathers are high-energy foods and a good source of concentrated fiber. Many contain vitamins A and C, as well as iron, potassium, and phosphorus.
- Q. Is sulfur harmful or dangerous?
- A. No, not in the amounts recommended for fruit drying. Inorganic sulfur passes readily through our bodies and is soon excreted. Used in fruit drying, it helps to retain vitamins A and C, flavor, and color, and prevents souring.
- Q. Is it better to burn flowers of sulfur than to use a metabisulfite dip?
- A. Each treatment has advantages. Dipping can be done indoors, which is important when there is no access to an area outdoors for burning sulfur. However, dipping increases the moisture content of the fruit, thereby increasing drying time, and causes leaching of soluble nutrients from the fruit tissues. Burning sulfur is a more convenient method for drying soft fruit because the fruit tends to fall apart in a dip.
- Q. How important is pasteurization of dried foods?
- A. Pasteurization is strongly recommended for vegetables that are dried in the sun or at temperatures below 65°C (e.g., oven drying). Pasteurization destroys the spoilage organisms that could still be active after food has been dried under these conditions.
- Q. Why does fruit turn brown?
- A. The naturally occurring tannin or protein and sugar groups join chemically to form the brown color. The fruity aroma is lost, and some vitamins and flavor are destroyed.
- Q. What can be done to prevent browning of dried fruit?
- A. Browning can be inhibited with the appropriate predrying treatment as described in Table 2. Fruits with light-colored flesh require a sulfur treatment, ascorbic acid dip, or syrup blanch to inhibit browning during drying.
- Q. Can lemon or pineapple juice be used instead of ascorbic acid to stop browning?
- A. Yes, these juices can be used, but because they are only about one-sixth as effective as pure ascorbic acid, a large amount is required to stop browning. Fruit treated with these juices acquires a lemon or pineapple taste, masking the true flavor.
- Q. Is there any type of wood that is not good for constructing drying trays?
- A. Yes. Green wood warps and weeps when heat is applied to it. Pine imparts a resinous taste to dried foods, and oak or redwood tends to stain the food. Perforated tempered hardboard makes suitable trays and can be obtained from a building-supply dealer.
- Q. Should all fruits be dried to a leathery hardness before they are stored?

- A. Fruits that are not completely dried will spoil unless they are frozen. However, apricots that are dried to the texture of a gumdrop and stored frozen are delicious to eat after thawing.
- Q. How do I know if the dryer is overloaded with fruit?
- A. If the dryer is at an operating temperature before loading, it should return to this temperature within 4 hours after loading.
- Q. If the drying cabinet is located indoors and is not portable, how can the fruit be sulfured out-of-doors?
- A. Load drying trays with fruit and stack them, separating one tray from another with bricks or blocks of wood. Place a large, tight cardboard box over the trays during the sulfur-burning step. (see Fig. 10).

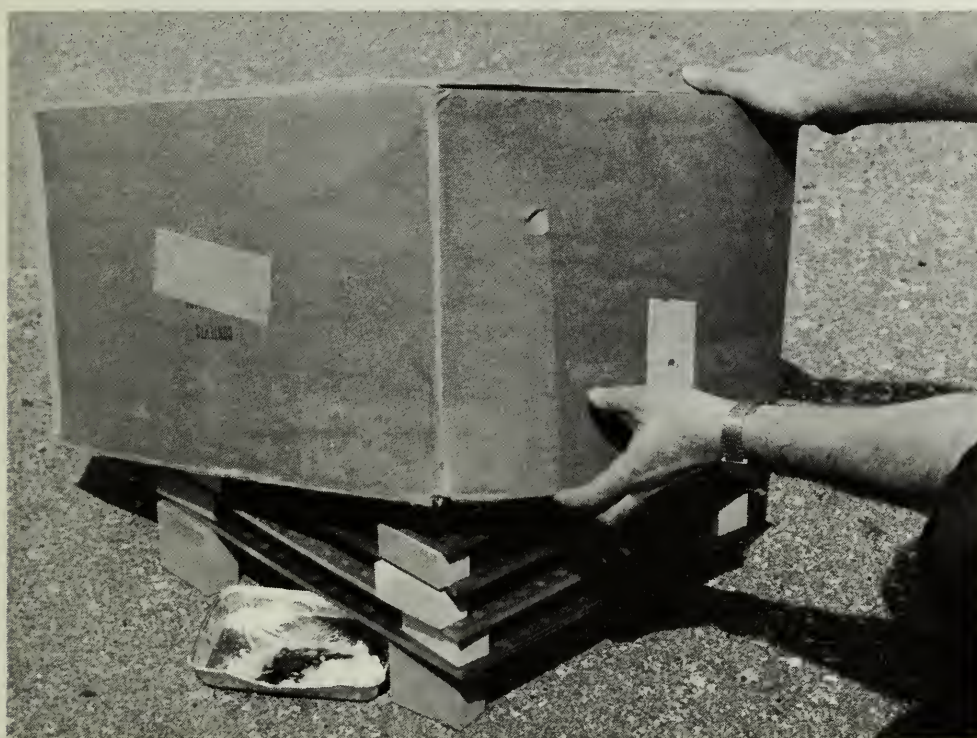


FIG. 10 Sulfuring fruit out-of-doors.

BUILDING A HOME DRYER

Cabinet

Details for constructing a simple cabinet dryer (Fig. 11) are shown in Figs. 12a–12d. The box can be made from any suitable lumber; 11-mm plywood (select sheathing grade) is satisfactory. When assembling the box, position the door butt hinges so that they protrude at least 5 mm on the front side. This will allow the door to swing back far enough to stay open (Fig. 11). Any simple fastener can be used to hold the door closed. Fasten strips of 19 × 19-mm lumber under the top of the box with nails or



FIG. 11 A home-built cabinet dryer with light-bulb heat source (see Fig. 12 for construction details).

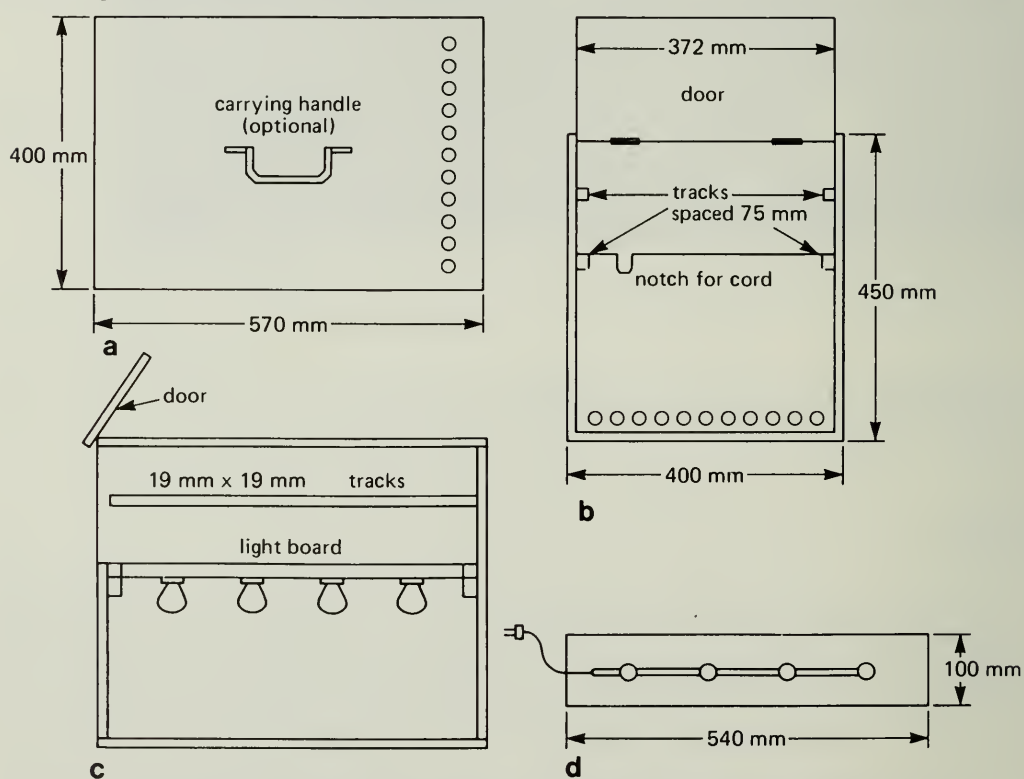


FIG. 12 A plan for a home-built plywood cabinet dryer: (a) top view; (b) front view; (c) side view; (d) light board.

screws to form a track for the light-bulb holder. On a 540 × 100 × 19-mm board (Fig. 12*d*), surface-mount four porcelain sockets wired in parallel and fit them with 60-watt light bulbs. Drill a series of 9-mm holes on 25-mm centers in this board to allow air circulation. Fasten a reflecting strip of foil to the board, extending 50–75 mm out from the edge. Make a notch for the light cord to slip through (Fig. 12*b*).

Drill ten 16-mm holes in the front of the box near the bottom and again at the top (rear) to provide air circulation. Line the bottom of the box with foil to reflect heat and to collect syrup that may drop from the fruit.

Trays for the dryer

Figure 13 illustrates a drying tray made from 6-mm tempered, perforated hardboard. The hardboard should be saturated with food-grade mineral oil before use, to keep the fruit from sticking during drying. The raised center section (Figs. 14*a* and 14*b*) is added only if needed for drying fruit leathers and is best made from 12-mm cove with the curved section facing inward.

A drying cabinet can easily be enlarged. For example, to build a cabinet that takes four trays instead of two, extend the vertical dimensions by 150 mm, add a second light bar next to the first, and add two more sets of tracks to support the trays. More accurate temperature can be achieved by controlling the light bulbs with an incandescent dimmer switch. To reduce drying temperature, cut down the voltage to the bulbs.

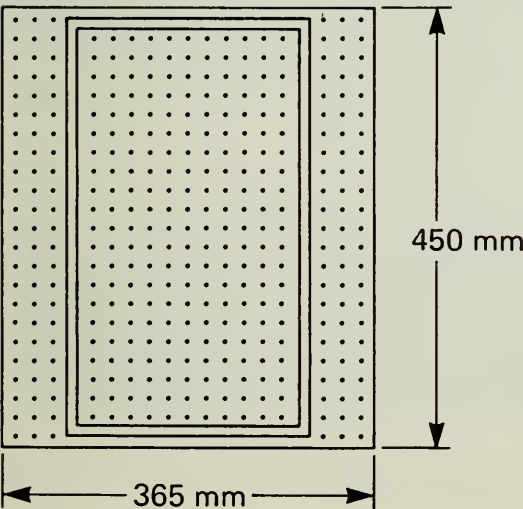


FIG. 13 A drying tray (top view).

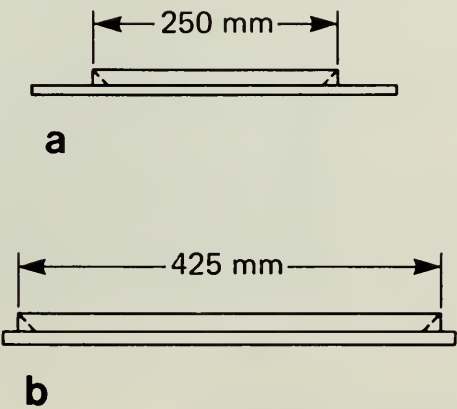


FIG. 14 A drying tray with an elevated border, added for drying fruit leathers: (a) end view; (b) side view.

Refrigerator

A discarded refrigerator cabinet (Fig. 15) works well with a 110-volt fan-driven car warmer to heat it. The thermostat of the car warmer should be capable of allowing the temperature to reach 65°C. If there is a stop to prevent this, you may have to alter or remove it, or replace the thermostat. The heater should be put into a hole at the base of the refrigerator so that it draws air from outside. Drill enough holes in the top of the refrigerator so that they equal (in area) the air intake of the heater. You will probably want to replace the shelf supports and add extra shelves to increase the drying capacity. Perforated hardboard is suitable for shelving. If the refrigerator has a mechanical catch on the door, replace it with a magnetic catch for the safety of children.

SOLAR DRYING

Sun-dried foods were the key to survival of many ancient civilizations, but we can still improve on these time-proven techniques by designing devices to trap more heat and to speed the rate of removal of moist air.

Direct sunlight

Drying food in direct sunlight consists of spreading the food on trays facing the sun and allowing breezes and convection currents to carry away moist air. Trays should be at least 20 cm above the ground to minimize the cooling effect of the ground. Place trays on a low roof or next to a wall with a southern exposure to accelerate drying. Light-colored fruits should be treated to resist browning and vegetables should be blanched. Take food indoors at night to avoid spoilage when the temperature drops and dew collects. Pasteurizing vegetables after drying helps to preserve them.

Greenhouse or cold frame

Drying in a greenhouse or cold frame is similar to drying out-of-doors but takes only half to three-quarters of the time. The glass or plastic cover of a greenhouse or cold frame increases the efficiency of drying by trapping and retaining heat that would normally be lost by radiation or air movement.

Solar collector

Drying with a solar collector can be as rapid as drying with an electrically heated cabinet, if the collector and cabinet are well designed. Spread the fruit on trays, stacked and separated by bricks, wooden blocks,

wooden fruit boxes, or shelves to allow at least 5 cm between the trays for air circulation. Fruit should be moved around in the dryer to ensure uniform drying. The collector should be turned to face the sun two or three times throughout the day to ensure efficient heat collection. If fruit is still quite wet at sunset, it may spoil overnight. It is therefore a good idea to cut and prepare fruit in the afternoon, heat it with sulfur overnight, and start drying in the early morning. If it rains for several days during drying, fruit may be spoiled before the drying process can be completed, unless an alternative source of heat is available.

Solar dryers can be designed in many ways. Figure 16 shows two possible designs. Dimensions are approximate. The heat-collecting ability of a flat-plate solar collector varies with changes in the surface area, and you may wish to experiment with different sizes until you find one that suits your needs.

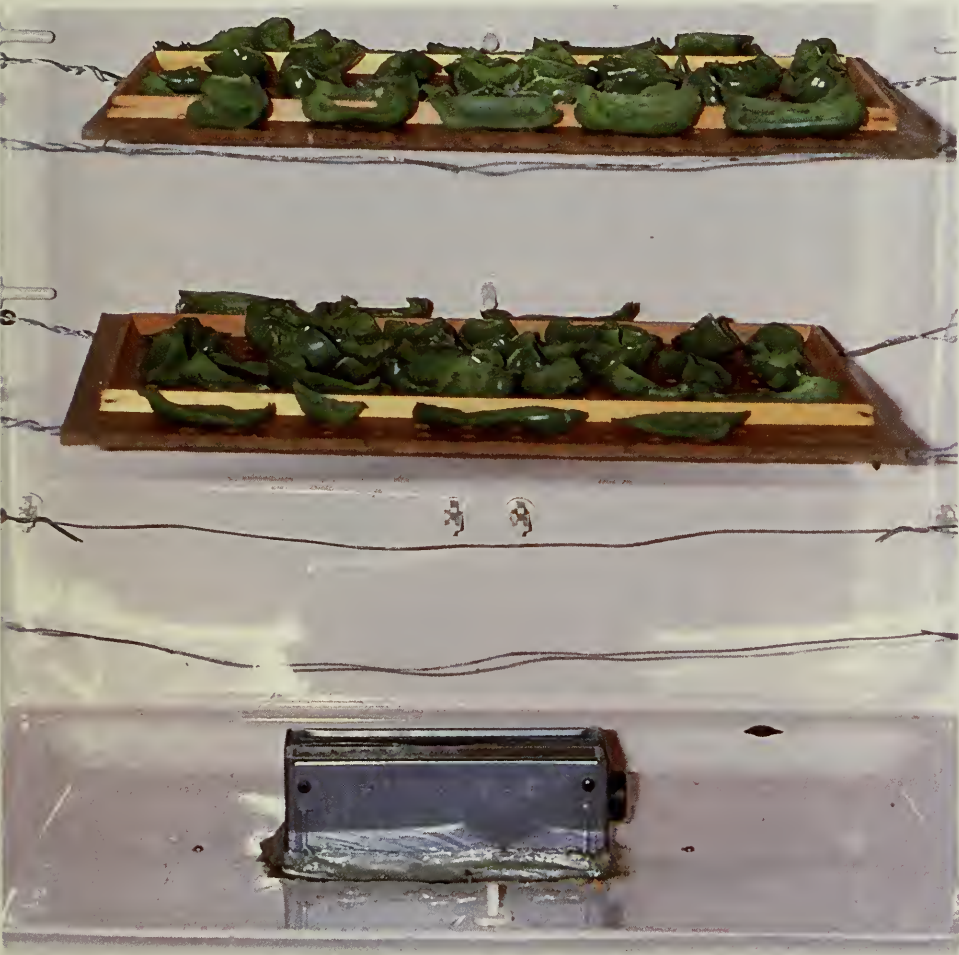


FIG. 15 A refrigerator converted to a dryer. Note heater at the base.

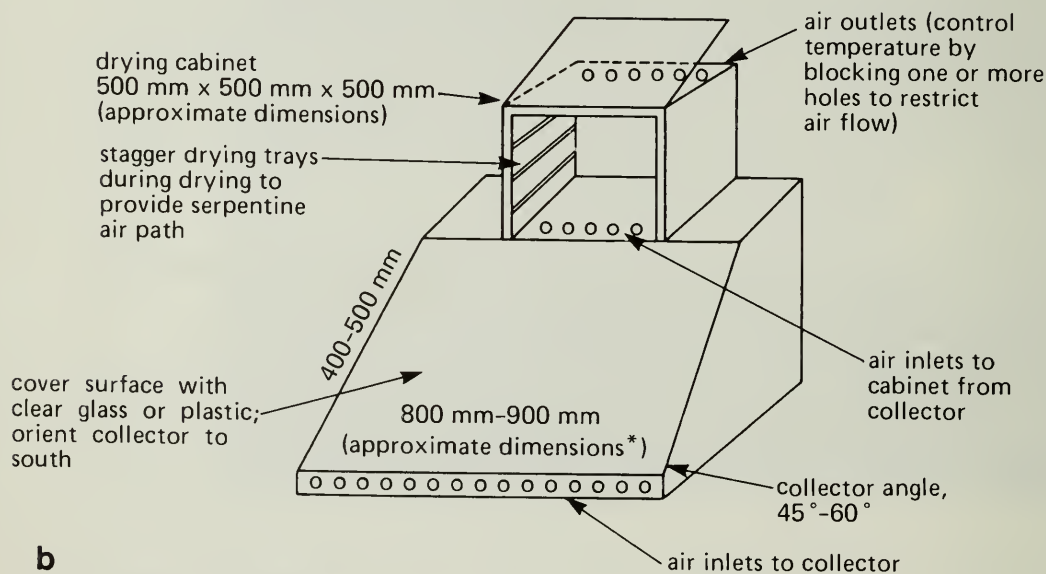
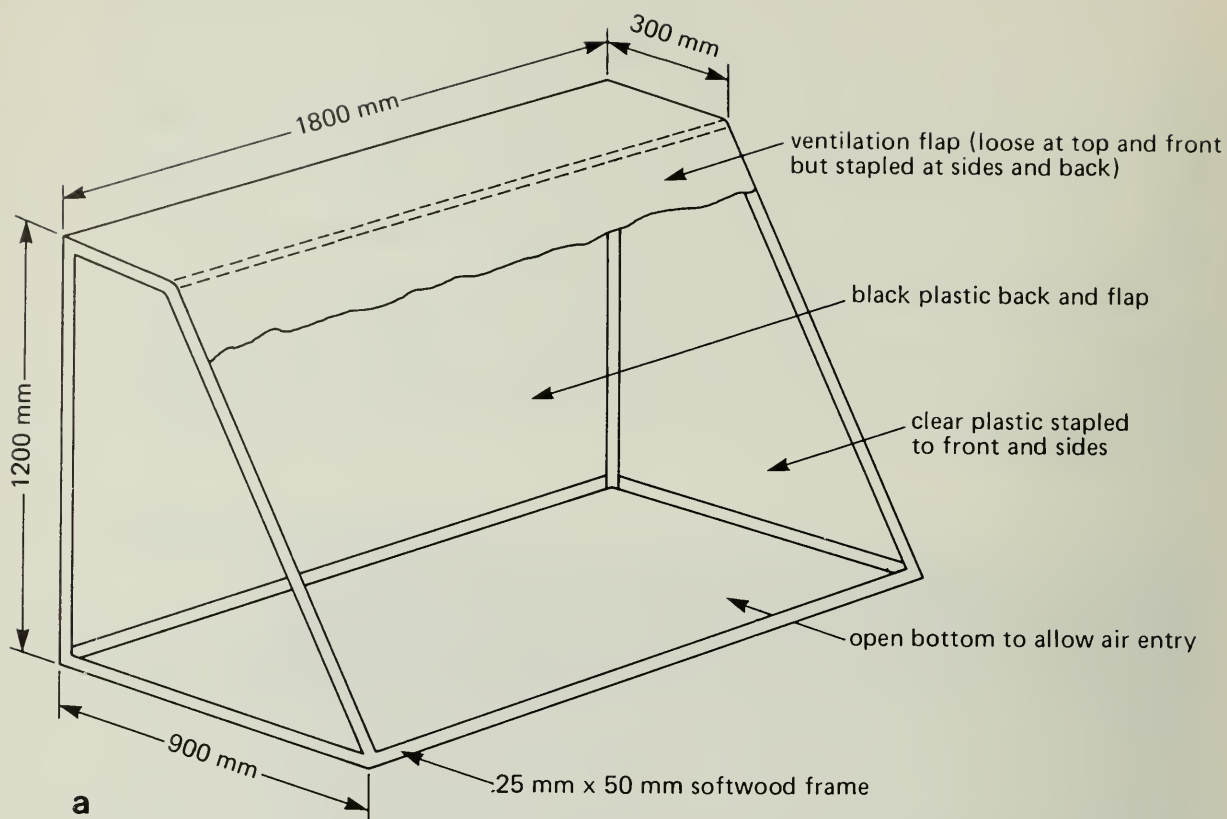


FIG. 16 Two types of home-built solar dryers: (a) tent-style dryer; (b) drying cabinet heated by flat-plate solar collector.

*Area of collector should be two or three times total area of trays in cabinet.

POINTS TO CONSIDER WHEN BUYING OR BUILDING A DRYER

- **Heat source and effective air circulation.** The dryer must be able to remove the water vapor efficiently without excess condensation inside the cabinet.
- **Temperature control.** For proper drying, the dryer temperature should be adjustable by means of a thermostat or rheostat. The dryer must have a heat source that is powerful enough to maintain a minimum temperature of 65°C when the dryer is fully loaded.
- **Dryer capacity.** Decide whether the dryer is large enough to produce enough dried food during the drying season to meet your needs.
- **Type of trays.** Trays should be constructed of noncorrosive material so that they are not affected by acids in the food being dried. Trays should have a perforated, slotted, or screened bottom to allow air circulation.
- **Safety features.** Any dryer fan or heater should be shielded to protect it from juices or food particles. A thermostatic cut-off for high temperature is also a good feature in electrically heated dryers.
- **Portability.** It is useful if the dryer is light enough to be moved easily.
- **Cost.** The price of a dryer can vary considerably, depending on the type, size, cabinet material, and special features. Make sure the dryer would be used enough to make its purchase or construction worthwhile.

CONVERSION FACTORS

Metric units	Approximate conversion factors	Results in:
LINEAR		
millimetre (mm)	x 0.04	inch
centimetre (cm)	x 0.39	inch
metre (m)	x 3.28	feet
kilometre (km)	x 0.62	mile
AREA		
square centimetre (cm ²)	x 0.15	square inch
square metre (m ²)	x 1.2	square yard
square kilometre (km ²)	x 0.39	square mile
hectare (ha)	x 2.5	acres
VOLUME		
cubic centimetre (cm ³)	x 0.06	cubic inch
cubic metre (m ³)	x 35.31	cubic feet
	x 1.31	cubic yard
CAPACITY		
litre (L)	x 0.035	cubic feet
hectolitre (hL)	x 22	gallons
	x 2.5	bushels
WEIGHT		
gram (g)	x 0.04	oz avdp
kilogram (kg)	x 2.2	lb avdp
tonne (t)	x 1.1	short ton
AGRICULTURAL		
litres per hectare (L/ha)	x 0.089	gallons per acre
	x 0.357	quarts per acre
	x 0.71	pints per acre
millilitres per hectare (mL/ha)	x 0.014	fl. oz per acre
tonnes per hectare (t/ha)	x 0.45	tons per acre
kilograms per hectare (kg/ha)	x 0.89	lb per acre
grams per hectare (g/ha)	x 0.014	oz avdp per acre
plants per hectare (plants/ha)	x 0.405	plants per acre

